STSM Report:

Red Organic Pigments: hyper-spectral acquisition on historically accurate reconstructions

Abstract

UV-Vis-NIR Fibre Optic Reflectance Spectroscopy (FORS) was applied to characterise and discriminate between historically accurate paint reconstructions of brazilwood (vegetal origin) and cochineal (animal origin) lake pigments. Paints were prepared with both pure pigments and their mixtures, in order to see how the presence of different chromophores and other pigments, as well as the nature of their application, might influence the analytical data obtained. The same paint reconstructions were also analysed with hyper-spectral Vis-NIR imaging spectroscopy (IS), which extends the measurement domain of one-dimensional (1D) reflectance spectroscopy, to the two-dimensional domain (2D). A comparison was made between data obtained with both methods in order to explore the potential, constraints, and practical aspects of IS for the study, identification and differentiation between red organic dyes and lake pigments.

The data acquired with the hyper-spectral technique proved to be in very good agreement with the reflectance spectra obtained with FORS (similar shapes with regard to position of the absorption bands and absorption intensity), showing that IS is effective to expand the information gathered from the 1D domain. Moreover, the two analytical methods have high spatial and spectral resolution. Both made possible to discriminate between the natural red dyes of vegetable and animal origin since brazilwood and cochineal present characteristic features in the visible range. However, the way in which paints were applied proved to have influence in the spectra obtained, which sometimes lack precise features that enable an accurate identification.

The hyper-spectral scanner had also the advantage of providing accurate RGB visible images of the paint samples with high quality and resolution, from which it is possible to select each point (areas of ca. 0.36 mm x 0.36 mm) and obtain the respective reflectance spectrum.

This mission developed at IFAC-CNR, under the supervision of Marcello Picollo, and with support of his team was a starting point for the development of a complete database on red organic dyes and lake pigments, applying non-contact spectroscopic analytical methods. Its purpose is to help identify such coloured materials, and their state of conservation in an artwork, while building a foundation for an optimised and adapted use of these spectral techniques.